On-Farm Irrigation PUBLICATION

Fertigation

Water Management Series
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Introduction:

"Chemigation" is the application of any chemical through irrigation water. This may include insecticides, fumigants, nematicides, fertilizers, soil amendments, and other compounds. By far, the most common form of Chemigation is "Fertigation," which refers to fertilizer application in the irrigation water.

This book emphasizes Fertigation.

Fertigation offers several distinct advantages in comparison to conventional application methods.

1. Soil compaction is avoided because heavy equipment never enters the field.
2. The crop is not damaged by root pruning, breakage of leaves, or bending over, as occurs with conventional chemical field application techniques.
3. Less equipment may be required to apply the chemical.
4. Less energy is expended in applying the chemical.
5. Usually less labor is needed to supervise the application.
6. The supply of nutrients can be more carefully regulated and monitored.
7. The nutrients can be distributed more evenly throughout the entire root zone or soil profile.
8. The nutrients can be supplied incrementally throughout the season to meet the actual nutritional requirements of the crop.
9. Nutrients can be applied to the soil when crop or soil conditions would otherwise prohibit entry into the field with conventional equipment.

EXTENT OF CHEMIGATION USE

Fertilizers have been applied through a wide range of irrigation systems for many years. Because most of the older traditional methods had significant worker contact with the

water (such as with furrow irrigation and hand move sprinklers), fertilizers were the most commonly injected chemicals.

With the introduction of center pivots and linear moves, the application of various forms of pesticides became more widespread, especially in the Midwestern U.S.

Significant advancements have been made to the design of special components of these machines to enhance chemigation, including the development of commercial under-canopy spray heads to apply insecticides to the undersides of leaves, and high speed gearboxes for the drive units, enabling fast movement of the machines across the field for light applications of chemicals. The center pivots and linear moves have some peculiar traits for pesticide applications that are not common to some other irrigation methods—they do not require the presence of people in the field during irrigation, and they are capable of quick, small, and very uniform applications of water. Furthermore, they can wet the
leaves on the plants, which surface irrigation methods cannot do.

Fertigation, through center pivots in the Midwest, has become fairly sophisticated in some areas. This sophistication has been assisted by the fact that most center pivots are found on a relatively small number of crops—principally small grains, soybeans, and hay. The fertility requirements of crops are fairly well established based on decades of research.

Drip and microirrigation equipment development especially in California, have stimulated a parallel growth in chemigation. An increasingly wide range of fungicides, herbicides, and insecticides are injected through drip and microirrigation systems. The extent of this type of chemigation appears to be largely dependent on the crop type, and is more prevalent and sophisticated on row crops (vegetables and strawberries) than on trees and vines.

Drip and microirrigation have a characteristic not shared by other irrigation methods—fertigation is not optional, but is actually necessary. Fertigation provides the only good way to apply fertilizers physically to the crop root zone for permanent crops. On high value drip irrigated crops, such as lettuce, tomatoes, and peppers, the level of fertigation management for achieving high yields and crop qualities appears to exceed what is found with other irrigation methods and crops.

Results from a 1984 Farm and Ranch Irrigation Survey by the USDA Economic Research Service indicate that fertigation in the United States has been prevalent for some time. That survey revealed that fertigation was used on all of the major crops in the country to varying degrees.

ENERGY CONSERVATION

Chemigation offers a considerable number of benefits in terms of energy conservation. The most obvious savings occur because vehicles do not need to traverse a field to apply pesticides or fertilizers.

More significant energy savings occur due to the fact that less chemical is generally applied by chemigation than with conventional application techniques. There are significant energy requirements in the manufacture of nitrogen fertilizer (approximately 24,600 BTU per pound of nitrogen).

The ITRC, working with the CEC, has documented on a pepper field with row crop drip that the nitrogen fertilizer can represent 44% of the total annual energy consumption for a row crop drip system (9.3 MBTU/acre out of 20.9 MBTU/acre total) and 51% for a solid set sprinkler system on the same field. The total energy consumption included the energy for manufacturing plastic, filters, tractor travel, etc. In the documented field, the fertilizer application stayed approximately the same for the first year of drip irrigation, but the yield increased by 50%. Effectively, this means that the fertilizer requirement was reduced per ton of produce.

Many row crop growers report typical decreases in fertilizer application to be in the 25% range once they convert to drip irrigation and employ good fertigation practices.

The MBTU/acre saved will obviously depend on the crop. For example, vines traditionally have low fertilizer inputs, so the MBTU/acre saved would be less.

Fertigation allows growers to manage crop nutrients at a level which is unprecedented, and impossible to achieve with conventional fertilizer practices. The result can be much higher yields and crop quality. Assuming a conservative estimate of a 10% increase in production due to better nutrient management, this represents a 10% increase in energy efficiency for all farming operations.

When discussing energy efficiency, the following definition is often used:

Energy efficiency (old concept) = (Energy consumption/acre)*100

Our understanding of energy efficiency has improved, and now we discuss agricultural energy efficiency as:

Energy efficiency (new concept) = (Energy consumption/amount of crop sold)*100

By increasing the amount of crop produced or sold through fertigation, the energy efficiency is increased.

Chemigation with pesticides also allows growers to increase yields or crop quality. With some forms of irrigation, notably drip and center pivots, systemic insecticides can be applied to the crop immediately after an insect infestation is noticed. The soil does not

have to dry out for tractor access after a rainfall, for example. Pesticides can be applied quickly before the blight or population spreads. This minimizes damage, and also reduces the amount of pesticide that must be applied.

In summary, the implications of using good irrigation and fertigation practices are tremendous in terms of improving agricultural energy efficiency. For many crops, good fertigation and irrigation practices provide more energy conservation than other practices that have previously been promoted.

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